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REPORT OF COMMITTEE ON WAR BURDENS OF WATER WORKS IN THE UNITED STATES

The Executive Committee of the American Water Works Association undertook to collect, for presentation before the annual convention of the Association, at St. Louis, May 13-16, 1918, information concerning the effect of war conditions upon the construction, operation and maintenance of water works in the United States. Replies to its call for information were received from about fifty municipally and corporately owned water works plants in the U. S. It was impossible to prepare this material in useful comparative form for presentation to the convention. A committee was therefore appointed to do this, which now presents its report.

GENERAL FINANCIAL CONDITIONS FACED BY WATER WORKS

Water works have suffered large increase in construction, operation and maintenance costs, due to war conditions. Marked decline in net revenue has resulted.

These conditions began to be generally felt late in 1916, but it was not until the latter part of 1917 that they became serious. Water works employees were true to their tasks; the desirability and continuity of their employment tended to stay the advance in their wages, which lagged behind the general advance in wages paid to labor, by a period of eighteen months, more or less. Men working in contractors' forces, in munitions and allied works, had long enjoyed very substantial, and in some war industries, abnormal increase in wages, before the increase came to water works employees.

But the advance in labor cost to American water works has gathered force in the last six months, and it is the general opinion of municipal and corporate managers that additional increases are certain to come during 1918 and thereafter, if labor is to be held. It is certainly undesirable to replace old well-trained forces, familiar with these properties, with other labor not having this familiarity, in the effort to hold the wages at a point below the general local standard for similar service. The character of the service would suffer. Serious and conscientious effort has been made by water

works operators generally, to reduce construction and operating forces and expenses to a minimum. These reductions have in many cases gone beyond desirable limits, even to reducing the working efficiency of the properties.

The general situation is a very serious one, from the point of view of the public, and an anxious one for the managers of water works. Already it has shown itself in increasing difficulty, and in many cases impossibility, of attracting capital to water works for necessary betterments. Moreover, it is inevitable that the Capital Issues Board will scrutinize more and more closely the diversion of funds to water works needs, particularly where those needs are not involved by governmental activities.

Pressure will doubtless be brought to bear to force communities to husband their water supplies, by reducing waste, leakage, and even unnecessary consumption, in order to curtail unnecessary investment in plant thus made necessary. No doubt, here as abroad, there may come a time when the smaller works will be unable to extend their service during the duration of the war, unless government needs be concerned, but it would be most unfortunate if the activities of an important city or of communities with manifold industrial and commercial industries were to be thus circumscribed.

The menace of the situation lies in the increasing difficulty, under such conditions, of maintaining constantly a water service, safe from a sanitary standpoint, necessary for good fire protection service, and adequate to industrial, commercial and domestic needs.

It appears clear that average pre-war prices will never again be realized and that the purchasing power of money has declined permanently the world over, as a result of the war, and will never be fully recovered. Present prices, which on most water works materials are double pre-war prices, and on labor 25 to 50 per cent greater, will probably not hold permanently after the war. Nevertheless, the old prices will not return as a whole.

The difficulty of the situation faced by utility properties in this country was clearly indicated in a letter addressed by the Secretary of the Treasury, Mr. McAdoo, to the President, on February 15, 1918, transmitting several memoranda prepared by committees of the American Electric Railway Association, The National Electric Light Association, the American Gas Institute and the National Commercial Gas Association, in which he called attention to the existence of genuine apprehension regarding the adequacy, under

present conditions, of the service and rates of local public utilities; that increased wages and high costs of essential materials and supplies have affected them, as they have affected everybody else; and that united effort will be necessary in order to meet alike the requirements of public service, and the corporate financial needs upon which that service depends. Concluding his letter to the President, the Secretary said:

I earnestly hope that you may feel justified in expressing the conviction that the vital part which the Public Utilities Companies represent in the life and war-making energy of the nation, ought to receive fair and just recognition by state and local authorities.

President Wilson in his reply to Secretary McAdoo, dated February 19, 1918, said:

It is essential that these utilities should be maintained at their maximum efficiency, and that everything reasonably possible should be done with that end in view. I hope that the state and the local authorities, where they have not already done so, will, when the facts are properly laid before them, respond promptly to the necessities of the situation.

Public Utility Commissions and other similar regulatory bodies in the United States have already shown their appreciation of the serious nature of the conditions confronting public utility properties, by granting increases in rates or the levying of surcharges on existing rate schedules in many cases, after careful review of the local conditions.

Valuation under present conditions is a very difficult, laborious and time-consuming task, and in view of the heavy burden of additional work under which these commissions are laboring, it is reasonable to believe that prompter consideration can be had by petitioning for relief, rather than for revaluation of property as a basis for change in rates.

How far these commissions will attempt to maintain the standard, heretofore avowed by them, of taking prompt action, to the end of reducing the unfair burdens of the people on the one hand and the hazard of investment and operation on the other, cannot now be determined. They may take the position that a portion of the abnormal expense, due to war conditions, must be borne by the works and a portion by the public, but in any event, it appears likely that they will not be insensible to pleas fairly directed toward the maintenance of corporate credit, and will recognize clearly that

it is not to the interest of the public to permit conditions which may destroy credit, and that credit seriously impaired or once destroyed cannot be re-established readily.

It was urged upon the members of the Association at the St. Louis convention, that the effort should be made to maintain operating efficiency, and that careful record should be made of change in cost of construction and operating materials and labor, so that if it should become necessary to make applications for advance in rates, on the part of either the municipally or the corporately owned works, the facts upon which the regulatory bodies could base sound judgment could be well established.

The following record of replies received from various municipally and corporately owned properties in this country, is submitted in tabular and graphical form, as evidence of the rapid change in conditions facing water works in this country from the years 1914 and 1915, which reflect the pre-war conditions, to the early part of the year 1918. All evidence points to yet more trying conditions for the future.

CONSTRUCTION LABOR AND MATERIAL COSTS

Advance in labor costs. Figure 1 shows the advance in the yearly average cost in cents per hour of unskilled labor to 44 American water works, arranged in four local groups. These indicate an average advance over pre-war prices prevailing in 1915 of 13 per cent in 1916 and 27 per cent in 1917, the fragmentary figures submitted for the opening of 1918 showing materially greater increase. It is important to note that comparison of past and present wage scales does not tell the whole story of increase in cost of labor to water works. Unfortunately, there has been marked decrease in efficiency. Your committee has made personal inquiry concerning this, within the last two months, from the managers of municipal as well as of corporate works, from the Pacific Coast to the East, and from the North to the South. In all cases, decrease in efficiency was reported. The estimates of percentage loss in efficiency, comparable with the efficiency of 1915 and prior thereto, varied from 20 to 50 per cent. The consensus of opinion seemed to range between 25 and 35 per cent.

It thus appears that the loss in efficiency of labor is practically equal to its increase in wage. The full increase in cost of labor,

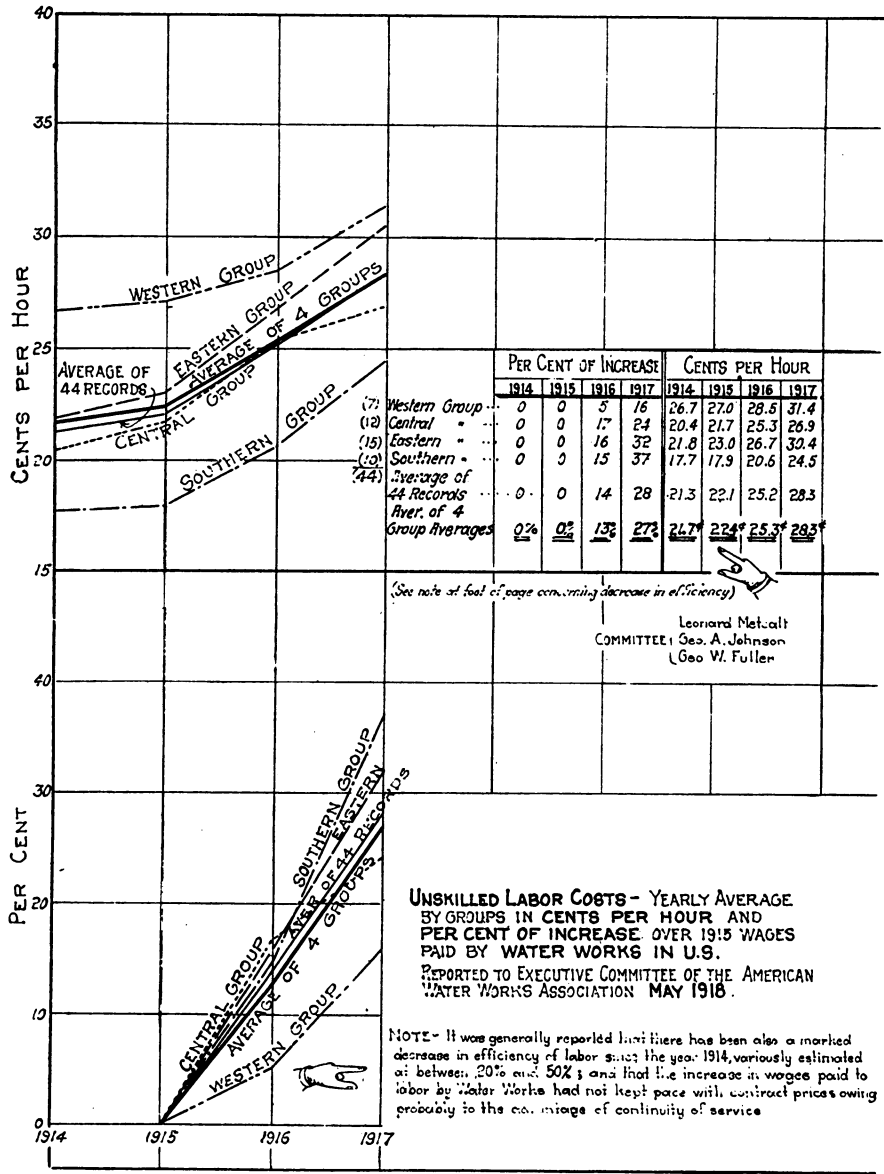


FIGURE 1

TABLE 1

Unskilled labor costs—average during year in cents per hour. Paid by water works in the United States

REFER- ENCE NUM- BER	STATE	POPULA- TION IN THOU- SANDS	1914	1915	1916	1917	1918
Western group							
45	California	575.0	25-28.1	25-28.1	28.1-31.3	31.3-34.4	31.3-37.5
46	California	523.0					
52	Washington	350.0	37.5	37.5			50.0
51	Oregon	275.7	37.5	37.5	37.5	37.5	40.6
47	Colorado	213.4	22.5	22.5	22.5	30.0	35.0
50	Kansas	67.8	17.5	20.0	22.5	27.0	
48	Iowa	27.1	25.0	25.0	25.0	30.0	
49	Iowa	14.0	20.0	20.0	25.0	25.0	
Total.....			186.7	189.0	199.7	219.9	
Average.....			26.7	27.0	28.5	31.4	
Central group							
25	Michigan	678.7	25.0	25.0	28.0	36.0	25.0
20	Indiana	269.5	20.0	20.0	22.0	24.0	
26	Illinois	72.1	25.0	23.3	27.0	30.0	
31	Wisconsin	45.5	15.0	25.0	30.0	35.0	
24	Indiana	25.2	22.5	22.5	25.0	25.0	
21	Indiana	20.3	20.0	20.0	22.5	20.0	32.5
29	Wisconsin	14.6	17.5	17.5	27.5	25.0	
28	Wisconsin	10.9	22.5	22.5	24.2	28.5	
30	Wisconsin	8.8	20.0	20.0	20.0	25.0	
22	Indiana	5.6	17.5	20.0	25.0	22.5	
23	Indiana	5.6	17.5	20.0	25.0	22.5	
27	Ohio	4.0	22.2	25.0	27.7	30.0	
Total.....			244.7	260.8	303.9	322.9	
Average.....			20.4	21.7	25.3	26.9	
Eastern group							
15	Pennsylvania	1,683.7					30.0
1	Massachusetts	745.1	25.0	25.0	25.0	30.0	
18	Pennsylvania	333.0	19.7	19.5	21.1	24.5	
16	Pennsylvania	150.0	18.0	22.5	29.0	35.0	
4	Massachusetts	110.0	31.0	31.0	31.0	24.0	
5	Connecticut	109.0	25.0	25.0	28.0	31.0	34.0
10	New York	99.4					30.0
14	Pennsylvania	40.4	22.2	22.2	30.0	30.0	
9	New York	36.9	25.0	25.0	25-30	30.0	

TABLE 1—Continued

REFERENCE NUM- BER	STATE	POPULA- TION IN THOU- SANDS	1914	1915	1916	1917	1918	
Eastern group—Continued								
11	Pennsylvania	26.6	20.0	22.2	30.8	33.3	33.0 37.0	
8	New Hampshire	26.0	20.0	25.0	28.0	33.0		
19	Pennsylvania	18.9	20.0	21.0	27.5	34.0		
13	Pennsylvania	15.0	22.2	22.2	29.7	33.3		
12	Pennsylvania	15.0	17.5	18.5	22.5	30.0		
17	Pennsylvania	14.4	20.0	21.0	22.5	25.0	25.0 30.0	
7	New Hampshire	4.9	22.0	25.0	25-30	30-37.5		
6	Maine	4.6	20.0	20.0	20.0	20-25		
2	Massachusetts	1.2	25.0	25.0	25.0	30.0		
Total.....			327.6	345.1	400.1	456.3		
Average.....			21.8	23.0	26.7	30.4		
Southern group								
41	Missouri	740.0	25.0	25.0	25.0	32.5	25.0	
37	Louisiana	372.0						
32	Alabama	174.1	15.0	16.5	18.0	22.5		
40	Missouri	84.0	19.0	17.5	18.5	20.0		
34	Florida	62.6						
42	Tennessee	58.6	13.5	13.5	20.0	20.0		
33	Arkansas	55.2	15.0	15.0	20.0	27.5		
43	West Virginia	43.6	17.5	17.5	20.0	25.0		
43	Virginia	38.6	12.2	15.0	20.0	25.0		
35	Kentucky	35.0	20.0	20.0	22.5	25.0		
38	Missouri	33.0	19.5	19.0	20.0	25.0		
36	Kentucky	7.8	20.0	20.0	22.0	22.0		
Total.....			176.7	179.0	206.0	244.5		
Average.....			17.7	17.9	20.6	24.5		
Average.....			21.3	22.1	25.2	28.3		

Unskilled labor costs—information received too late to be included in the original table

REFERENCE NUMBER	GROUP	POPULATION IN THOUSANDS	1914	1915	1916	1917	1918
New York City	Eastern	5,359.					
3	Eastern	16.8	20.7	20.0	25.0	30.0	25.0
10	Eastern	111.0	19.3	17.5	25.9	26.7	
20	Central	289.0	20.0	20.0	22.0	24.0	
34	Southern	68.8	18.0	18.0	18.0	19.0	

TABLE 2

Labor costs in water works pipe extensions, repair work, etc., in the United States. Approximate average cost in cents per hour for skilled and unskilled labor (combined). Found by taking from the pay rolls the total labor cost and dividing it by the man-hours involved Prepared by Leonard Metcalf Feb. 22, 1918.

NOTE. Construction work has been seriously curtailed since 1914 and in most cases could not have been executed at the wage rates here shown, had it been necessary to enlarge the organizations of the works here shown.

LOCATION OF WORKS	POPULATION SERVED (APPROXIMATE)	AVERAGE NUMBER OF MEN (APPROXIMATE)	PRE-WAR CONDITIONS			1915	1916	1917	1918
			1912	1913	1914				
1. Milford, Mass.....	16,000	7 to 23	22.6	22.7	21.6	21.0	25.4	30.8	3 mos. only
2. Worcester, Mass. (sewer department).....	160,000	94 to 374	25.0	25.0	25.0	25.0	26.0	29.0	
8 hour day minimum wage here shown for Worcester									
3. Central N. Y.....	100,000	21 to 95	21.5	26.2	24.1	21.3	29.2	31.0	
4. Central Pa.....	330,000	26 to 35	20.6	21.5	21.7	21.8	23.6	24.5	
5. Western Pa.....	100,000								
6. Central Ind.....	275,000	52	20.9	22.0	22.0	22.0	24.5	26.2	27.3
7. Northern Ind.....	30,000	17 to 36	24.8	24.8	24.8	24.8	29.2	31.5	38.2
8. Los Angeles.....	500,000	3700-7800	33.6	34.0	35.6	35.1	36.5	37.7	
Average of seven records above.....			24.2	25.2	25.0	24.4	27.8	30.3	
Average (of three years).....				24.8		98.4%	112.2%	122.2	
9. San Francisco, Cal.....	450,000								Jan.
Spring Valley Water Co.....									
a In City Distribution Department.....		Aver. 34 to 63 = 45		36.0		34.6	38.5	42.3	42.8

b In Service and Meter Department.....	42 to 88 = 56	41.1	39.3	39.6	42.6	46.7
c In (San Mateo) Water Division.....	26 to 87 = 51	34.1	37.0	34.2	37.4	41.2
d In Alameda County.....	24 to 44 = 33	27.4	27.3	26.6	28.5	33.9
Average (a, b, c, d).....	Average = 185	35.4	35.5	36.2	39.4	41.7
Common labor.....		100%	100.5%	102.2%	111.2%	118.0%
f In Calaveras (Dam).....	187 to 478 = 328	(29.7)	(30.8)	(29.9)	(32.5)	(35.7)
		28.2	27.5	29.3	30.6	33.6
	Average = 513	31.0	32.0	31.7	34.3	36.9
		100%	103.2%	102.2%	110.7%	119.1%
Treating Calaveras figures as a separate item from the average Spring Valley Water Company figures, we have						
Average (9).....		26.6	26.0	28.9	31.2	
Spring Valley Water Company.....		100%	97.8%	108.7%	117.2%	
		31.0	32.0	31.7	34.3	36.9
		100.0%	103.2%	102.2%	110.7%	119.1%

Conclusion. The average rate paid in cents per hour for skilled and unskilled labor (combined) upon the works here recorded, was in

1915 approximately equal to the rate of 1912-13-14;

1916 approximately 9 per cent above the rate of 1912-13-14;

1917 approximately 17 per cent above the rate of 1912-13-14;

And for the Spring Valley Water Company of San Francisco for

1915 and 1916 approximately 3 per cent above the rate of 1912-13-14;

1917 approximately 11 per cent above the rate of 1912-13-14;

January, 1918, approximately 19 per cent above the rate of 1912-13-14.

Note that these records give no indication of the *decrease in efficiency* which has taken place.

due to the combined effect of loss in wages and loss of efficiency, is approximately 50 per cent in excess of the pre-war costs and nearly as much over those of 1916.

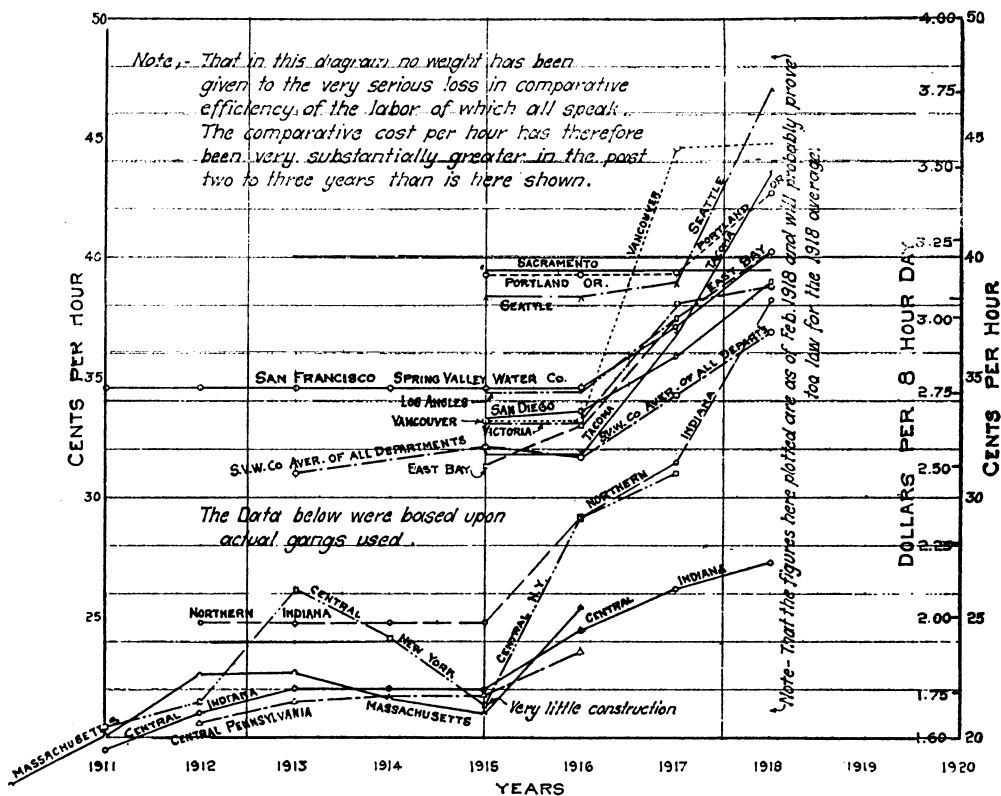


FIG. 2. LABOR COSTS PER MAN-HOUR PAID BY AMERICAN WATER-WORKS, BASED UPON THE ACTUAL AVERAGE COST PER MAN-HOUR OF A GANG OF 50 MEN COMPRISING FOREMAN, SUBFOREMAN, 4 CALKERS, 6 PIPE LAYERS, BLACKSMITH AND 37 LABORERS.

Similar data were gathered by one of the members of this committee at a slightly earlier date, with reference to the advance of labor costs in different parts of this country.

In figure 2, data relating to the central and eastern works were based upon the actual construction gangs used by the works referred

to; the data relating to the western works were based upon the normal gang, or gangs, totalling 50 men. Similar information to that relating to the eastern works was included with reference to the average cost of labor in all departments of the Spring Valley Water Company.

TABLE 3

Increase in cost of water works, cast iron pipe 6 inches and larger

REFERENCE NUMBER	STATE	POPULATION IN THOUSANDS	1914	1915	1916	1917	1918
Eastern group							
4	Massachusetts	110.0	\$22.13	\$20.30	\$27.10	\$38.39	\$57.00
5	Connecticut	110.0	22.60	21.70	31.00	59.00	
6	Maine	4.6	24.55†	26.78†			
7	New Hampshire	4.9	21.50†		34.93†		
8	New Hampshire	26.0	24.95	23.86	30.73	32.34	
9	New York	36.9	22.40	21.52	29.50	55.10	54.70
19	Pennsylvania	18.9	24.10	23.10	26.20	44.10	56.25
New York	New York	*	21.20	23.20	31.60	55.40	
Boston	Massachusetts		21.10	17.05	29.15	45.18	
Totals.....			158.48	150.73	205.28	329.51	167.95
Sub-averages.....			22.63	21.52	29.35	47.10	
Central group							
25	Michigan	678.7	23.45	23.45	30.50	30.50	
28	Wisconsin	10.9	25.40	29.30	(†)	59.60	
Chicago	Illinois	..	24.10	24.50	31.80	54.60	
Totals.....			72.95	77.25	62.30	144.70	
Sub-averages.....			24.32	25.75	31.15	48.23	
Southern group							
35	Kentucky	35.0	23.15	22.70	29.70	56.00	53.00
37	Louisiana	372.0	21.00	22.50	22.50	56.00	
41	Missouri	740.0	22.60	22.85	29.95	62.00	
Birmingham	Alabama		18.80	19.00	26.10	48.80	
Totals.....			85.55	87.05	108.25	222.80	
Sub-averages.....			21.39	21.76	27.06	55.70	

TABLE 3—Continued

REFERENCE NUMBER	STATE	POPULATION IN THOUSANDS	1914	1915	1916	1917	1918
Western group							
45	California	575.0	30.60	30.59	38.01	62.50	62.20
47	Colorado	213.4	30.00	30.00	36.75	63.75	63.00
51	Oregon	275.7	30.21	29.48	33.95	45.27	63.50
52	Washington	350.0	30.75†				67.50
San Francisco	California		31.30	31.30	36.90	60.20	
Totals.....			122.11	121.47	145.61	231.72	256.20
Sub-averages.....			30.53	30.34	36.40	57.93	
Grand totals (18 works).....			\$439.09	\$436.40	\$521.44	\$928.73	
Average.....				24.23	30.70	51.60	
Per cent of increase over 1915 costs					26.7	112.9	
<i>Data received too late to include in above table</i>							
New York	New York†.....	5,468.0	\$20.45	\$22.22	\$31.14	\$52.48	
3	Massachusetts		22.65	23.55	None	None	
10	New York		22.04	21.62	27.60	33.58	
20	Indiana		21.65	21.38	25.58	45.88	54.78
34	Florida		22.74	22.28	28.42	51.40	
46	California		31.30	31.30	39.00	57.70	64.10

* Market price given in *Iron Age*.

† Omitted from totals and averages.

‡ Department of Water Supply, Gas and Electricity.

The labor costs involved in maintenance and operation are covered in the discussion upon the increase in cost of operation and maintenance of water works.

Advance in cost of cast iron pipe. The increase in cost of cast iron pipe of 6-inch and larger diameter, reported to the Committee, is indicated in table 3, which shows an increase in prices over those of 1915 of 26.7 per cent in 1916, and 112.9 per cent in 1917. The corresponding figures for 1918 are too fragmentary for averaging, but indicate a slightly smaller increase over 1915 than did the 1917 figures, by reason of the stabilizing effect of governmental control. The difference is nearly negligible, however.

Table 4 shows similar data, obtained by C. C. Cray, purchasing agent of the Indianapolis Water Company, from Chicago, Columbus, Cincinnati, St. Louis, Terre Haute, Evansville, and for New York City and other cities, which were unfortunately received too late for inclusion in the unit figures and averages shown in table 3.

Advance in cost of valves and hydrants. The increase in cost of 6-inch valves to eleven water works, in different parts of the country, is indicated in table 5. It shows an advance in price of 13.1 per

TABLE 4

Prices paid for cast iron pipe in seven cities, f.o.b. destination, tons of 2000 lbs.

	1915		1916		1917		1918	
	Tons	Weighted average cost	Tons	Weighted average cost	Tons	Weighted average cost	Tons	Weighted average cost
Chicago, Ill.....	27,765	\$21.86	20,681	\$27.54	15,255	\$34.95		
Columbus, O.....	2,606	21.50	950	30.51	1,238	43.23		
Cincinnati, O.....	8,500	22.37	4,592	27.71	1,179	41.26		
St. Louis, Mo.....	2,626	22.93	1,764	29.95	998	62.00		
Terre Haute, Ind.....	47	21.28	357	29.59	37	54.35		
Evansville, Ind.....	801	21.00	1,152	25.52	676	38.25		
Weighted average of 6 cities.....		21.82		28.47		45.67		
Indianapolis, Ind.....	2,150	21.38	1,794	25.58	2,046	45.88	113	\$54.78

cent in 1916, 71 per cent in 1917, and approximately 107 per cent in 1918, all as compared with pre-war prices.

Advance in cost of some other water works construction materials. In table 6 are shown data concerning the recent advance in cost of some other water works materials reported by C. C. Cray, purchasing agent of the Indianapolis Water Company; and in table 6a similar data reported by the Spring Valley Water Company of San Francisco.

TABLE 5
Increase in cost of water works valves and hydrants

	1914	1915	1916	1917	THREE MONTHS OF 1918
6-inch valves					
Eastern group (5)					
Massachusetts.....	\$10.50	\$10.50	\$10.50	\$15.00	24.28
Connecticut.....	10.50	10.50	11.50	20.00	
New York.....	11.80	11.80	13.00	16.50	
Pennsylvania.....	11.40	11.40	11.40	16.50	21.50
Pennsylvania.....	13.85	13.30	13.30	17.75	
Central group (2)					
Michigan.....	12.35	12.35	14.50	26.50	
Wisconsin.....	9.20	9.20	14.65	23.06	
Southern group					
Kentucky.....	12.50	12.50	12.50	16.50	
Missouri.....	11.40	11.00	12.95	20.60	
Western group					
California.....	6.714	7.618	10.501	14.01	
Colorado.....	12.80	12.80	14.20	24.00	
Grand Totals (11).....	123.01	122.97	139.00	210.42	45.78 ^(a)
Average (of 11).....	11.18	11.18	12.64	19.13	23.20*.
Per cent of increase over 1915.....			13.1	71.1	107.6
12-inch valves					
Connecticut.....	\$31.00	\$31.00	\$34.50	\$62.34	\$74.08
Pennsylvania.....	44.65	36.55	45.10	64.65	60.20
Michigan.....	36.80	36.80	45.00	69.00	
Grand totals (3).....	112.45	104.35	124.60	195.99	134.28 ^(a)
Average (of 3).....	37.48	34.78	41.53	65.22	69.00†
Per cent of increase over 1915.....			19.4	87.6	98.7
2-way hydrants					
1. Connecticut.....	\$33.40	\$33.40	\$42.70	\$54.75	\$60.24
2. New York.....	26.70	26.50	28.00	49.78	
3. Pennsylvania.....	31.75	31.75	43.50	42.00	
4. Kentucky.....	24.00	24.00	24.00	35.78	54.40
5. Louisiana.....	20.00	20.00	21.65	35.10	
6. Missouri.....	23.75	24.49	26.40	41.40	
Totals (6).....	159.60	160.14	186.25	258.81	114.64 ^(a)
Average.....	26.60	26.69	32.04	43.13	53.90†
Per cent of increase over 1915.....			20.1	61.6	102.0

TABLE 5—Continued

Data received too late to include in other table

REFERENCE NUMBER	1914	1915	1916	1917	THREE MONTHS OF 1918
6-inch valves					
Boston, Mass.					
New York, N. Y.		\$11.30	\$13.65	\$22.83	
3	\$9.00	9.00	13.00	None bought	
10	11.25	11.25	13.88	18.77	
20	21.65	21.38	25.58	45.88	\$54.78
34	22.74	22.28	28.42	51.40	
46					
12-inch valves					
Boston, Mass.					
New York, N. Y.			\$36.40	\$58.33	
3					
10	\$31.50	\$31.66	33.22		
20	33.00	33.00	39.33	52.50	\$63.00
34					
46					
2-way hydrants					
Boston, Mass.					
New York, N. Y.		\$24.77	\$31.15	\$45.75	
3	\$28.10	28.27	28.80	None bought	
10					
20	34.00	33.50	39.44	54.77	
34	32.00		28.10	51.40	
46					

Note:—For 1918, the average prices shown are for the first two or three months of the year only and are found by multiplying the 1917 average by the ratio of the sum of the items in 1918 to the sum of the corresponding items in 1917.

* Average of two items is \$22.89.

† Average of two items is \$67.14.

‡ Average of two items is \$57.32.

TABLE 6

Weighted average cost of construction materials to the Indianapolis Water Company for 1915, 1916, 1917 and three months of 1918, and percentage increase over 1915 prices

ITEM	UNIT	1915	1916	1917	1918 THREE MONTHS	INCREASED 1917 OR 1918 OVER 1915 <i>per cent</i>
1. Cast iron pipe.....	Ton	\$21.38	\$25.58	\$45.88	\$54.78	156
2. Cast iron fittings.....	100 lbs.	2.502	2.75	4.19		67
3. Pig lead.....	100 lbs.	4.469	6.555	10.77		141
4. Jute.....	100 lbs.	6.50	7.75	10.50		61
5. Valves, 6-inch.....	Each	11.25	13.88	18.77		67
12-inch.....	Each	33.00	39.33	52.50	63.00	91
6. Valve boxes.....	Each	1.60	2.03	2.35	2.72	70
7. Hydrants—2-way and steamer.....	Each	33.50	39.44	54.77		63
8. Corporation cocks, $\frac{1}{2}$ -inch.	Each	0.32		0.713	0.84	162
9. Stop boxes, 3-inch.....	Each	0.63	0.75	0.91	1.27	101
10. Brick, common.....	1000	8.00	8.50	10.50	13.00	62
11. Paving, common.....	1000	35.00				
12. Cement, Sacks inc.....	Barrel	1.80	1.959	2.207	3.00	66
13. $\frac{5}{8}$ -inch meters.....	Each	6.99	8.40*	9.86	10.50†	50
14. $\frac{3}{4}$ -inch meters.....	Each	10.50		14.83		
15. 1-inch meter.....	Each	14.00		19.50		
16. 2-inch meters.....	Each	41.65		62.36	62.50†	
17. 3-inch meters.....	Each	70.80		85.00		
18. Lumber Y. P.....	M	26.00	33.00	37.50	44.00	69
19. Sand and gravel.....	Load					
20. Reinforcing steel.....	100 lbs.	2.55	3.15	3.50	4.00	57

* Few purchases.

† Quotations.

TABLE 6 a

Prices paid by the Spring Valley Water Company, San Francisco

MATERIAL	PRICE NORMAL	PRICE JANUARY, 1918	PERCENT- AGE OF INCREASE	TOTAL PERCENTAGE OF INCREASE, WEIGHTED AVER- AGE
Oil, fuel, per barrel.....	\$0.70½	\$1.45	106.0	99.5
Oil, cylinder, per gallon.....	.53	.86	36.5	
Packing, flax, per pound.....	.40	.81	102.5	
Tubes, boiler, per foot.....	.32	.84	162.0	
Valves, rubber, per pound.....	.70	.90	28.5	
Waste, cotton, per pound.....	.09	.15	66.5	
Oil, dynamo, per gallon.....	.36	.531	47.5	50.0
Waste, cotton, per pound.....	.09	.15	66.5	
Polish, metal, per gallon.....	.85	.90	6.0	
Cheese cloth, per yard.....	.03½	.10½	180.0	180.0
Hay, per ton.....	18.00	30.00	66.5	66.5
Copper sulphate, per hundred- weight.....	5.50	10.75	95.5	95.5
Paint, per gallon.....	.65	1.10	69.5	69.5
Hay, per ton.....	18.00	30.00	66.5	66.5
Asphaltum, per ton.....	12.50	17.60	40.0	74.0
Coal tar, per barrel.....	6.00	12.00	100.0	
Oakum, per bale.....	4.50	8.75	94.5	
Lumber, base.....	12.50	24.00	92.0	
Nails, per hundredweight.....	2.35	4.70	100.0	
Paint, per gallon.....	.65	1.10	69.5	
Paint, per gallon.....	.65	1.10	69.5	85.0
Lumber, base.....	12.50	24.00	92.0	
Nails, per hundredweight.....	2.35	4.70	100.0	
Paint, per gallon.....	0.65	1.10	69.5	69.5
Meter parts.....			20.0	60.0
Fittings, brass, per pound.....	.35	.57½	64.5	
Fittings, galvanized.....	List less 85%	List less 65 and 10%	110.0	
Covers, meters, per pound.....	.03½	.06½	78.5	
Leather, per pound.....	.40	.70	75.0	
Picks, per dozen.....	6.50	12.75	96.0	

TABLE 6 a—*Concluded*

MATERIAL	PRICE NORMAL	PRICE JANUARY, 1918	PERCENT- AGE OF INCREASE	TOTAL PERCENTAGE OF INCREASE WEIGHTED AVER- AGE
Shovels, per dozen.....	11.00	18.50	68.0	60.0
Cutters, pipe, each.....	1.50	2.75	83.5	
Stocks and dies, each.....	5.00	8.00	60.0	
Wrenches, each.....	.75	1.50	100.0	
Pipe, cast iron, per ton.....	35.00	62.00	76.5	70.0
Fittings, cast iron, per pound.....	.03½	.06½	78.5	
Lead, pig, per pound.....	.04½	.07	65.0	
Jute, per pound.....	.06	.12	100.0	
Coal, per ton.....	10.00	13.00	30.0	
Picks, per dozen.....	6.50	12.75	96.0	
Shovels, per dozen.....	11.00	18.60	68.0	
Bars, crow, per pound.....	.04	.10	150.0	
Fittings, brass, per pound.....	.35	.56½	64.5	87.5
Fittings, galvanized.....	List less 85%	List less 65 and 10%	110.0	
Pipe, galvanized, per cubic foot...	4.50	10.05	124.0	
Pipe, lead, per hundredweight....	6.50	10.75	65.5	
Picks, per dozen.....	6.50	12.75	96.0	
Shovels, per dozen.....	11.00	18.50	68.0	
Cutters, pipe, each.....	1.50	2.75	83.5	
Stocks and dies, each.....	5.00	8.00	60.0	
Wrenches, each.....	.75	1.50	100.0	
Leather, per pound.....	.40	.70	75.0	
Office furniture.....			40.0	40.0
Stationery.....			50.0	
Printing.....			33.0	
Office furniture.....			40.0	50.0
Stationery.....			50.0	
Printing.....			33.0	
Hardware, builders'.....			50.0	
Shellac, per gallon.....	1.28	3.20	150.0	
Janitor's supplies.....			50.0	80.0
Lumber, per base.....	12.50	24.00	92.0	
Nails, per hundredweight.....	2.35	4.70	100.0	
Fencing, per hundredweight.....	2.65	5.55	109.5	
Paint, per gallon.....	.65	1.10	69.5	

ADVANCE IN COST OF OPERATING SUPPLIES

Turning now to important typical operating supplies, such as coal and alum, yet greater increase in price has taken place.

Coal. The prices paid for coal by 41 important water works, table 7, indicate an advance in prices in 1916, 1917 and early 1918, over those prevailing in 1915, of approximately 15, 74 and 117 per cent, respectively. It is interesting to note the variation in the different parts of the country. The East suffered in far greater measure than the South and the West; the Central States in like measure with the Southern and Western states in the years 1916

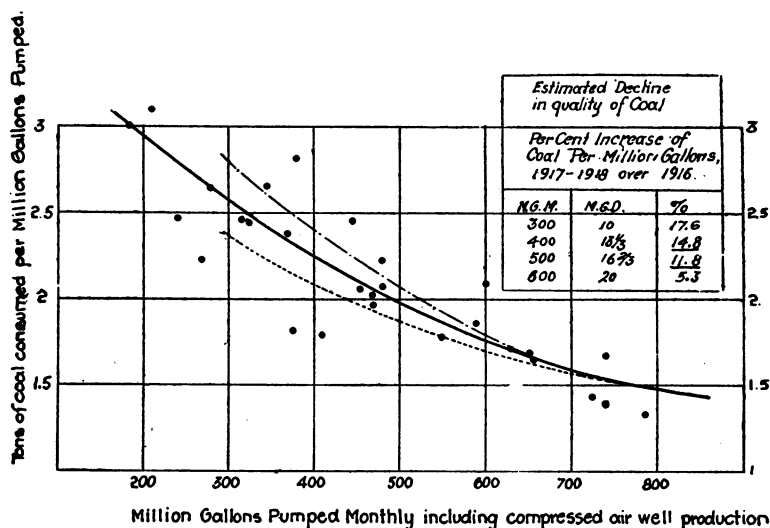


FIG. 3. PUMPAGE AND COAL FOR 28 MONTHS ENDING APRIL 30, 1918

and 1917, and in greater measure than any of the other groups in 1918. Incidentally, it may also be noted that the prices of fuel oil reported for one large plant in Louisiana and one in California show an advance in price in the opening of 1918 of approximately 150 per cent over those prevailing in 1915.

Unfortunately, in coal as in labor, the advance in unit prices does not reflect the entire increase in cost, inasmuch as decline in quality of the coal has been very generally observed. Effort was recently made to obtain exact information upon this subject by the Indianapolis Water Company through a study of the relative coal consumption per million gallons of water pumped during the past two years, or thereabouts. The results of this study, shown in figure 3,

TABLE 7
Increase in cost of water works fuel

REF. NO.	STATE	POPULA- TION IN THOUSANDS	COAL, DOLLARS PER TON				
			1914	1915	1916	1917	1918
Eastern group							
2	Massachusetts	1.2	\$5.56	\$5.56	\$6.71	\$11.21	
4	Massachusetts	110.0	4.18	4.20	5.33	10.00	
6	Maine	4.6	4.90	4.72	6.12	10.84	\$12.00
7	New Hampshire	4.9	4.38	4.39	5.04	8.05	
8	New Hampshire	26.0	4.80	4.90	6.75	9.00	9.00
9	New York	36.9	3.45	3.45	3.85	6.48	7.65
11	Pennsylvania	26.6	2.61	2.56	2.99	3.40	
12	Pennsylvania	15.0	1.21	1.24	1.68	2.55	
13	Pennsylvania	15.0	1.59	1.20	1.40	2.87	
14	Pennsylvania	40.4	1.27	1.45	2.84	3.67	
16	Pennsylvania	150.0	1.90	1.77	2.14	3.45	
17	Pennsylvania	14.4	1.82	2.08	3.33	4.33	
19	Pennsylvania	18.9	1.23	1.28	1.17	1.58	4.33
Totals.....			38.90	38.80	49.35	77.43	Average of four items is \$8.24
Sub-average of eastern group.....			2.99	2.98	3.80	5.96	7.04

Central group									
21	Indiana	20.3	2.02	1.91	1.96	2.55			
22	Indiana	5.6	1.21	1.11	1.77	2.87			
23	Indiana	5.6	1.25	1.25	1.86	3.13			
24	Indiana	25.2	1.83	1.94	2.16	2.90			
25	Michigan	678.7	2.29	2.21	2.37				
26	Illinois	72.1	1.34	1.49	1.88	2.67			
27	Ohio	4.0	5.40	5.32	5.40	5.34			
28	Wisconsin	10.9	2.89	2.87	2.67	3.85			
29	Wisconsin	14.6	2.32	2.18	2.73	4.82			
30	Wisconsin	8.8	3.52	3.51	4.53	5.45			
31	Wisconsin	45.5	2.75	2.72	3.17	4.45			
Totals.....			26.82	26.51	30.50	38.03	6.55	Average of one item is \$6.55	
Sub-average.....			2.44	2.41	2.77	3.75	6.38		

* Mine run screenings.

TABLE 7—Continued

REF. NO.	STATE	POPULA- TION IN THOUSANDS	COAL, DOLLARS PER TON				
			1914	1915	1916	1917	1918
Southern group							
32	Alabama	174.1	1.29	1.29	1.20	1.64	
33	Arkansas	55.2	2.33	2.31	2.46	3.34	
35	Kentucky	35.0	* { 1.75 0.90	1.75 0.90	1.75 0.90	1.90 1.00	3.00 1.50
36	Kentucky	7.8	1.88	2.55	2.61	4.52	
37	Louisiana	372.0	2.57	2.65	2.56	3.81	4.40
38	Missouri	33.0	2.14	2.08	2.50	3.52	
39	Missouri	4.5	2.02	1.91	1.96	2.82	
40	Missouri	84.0	2.06	1.75	2.07	3.30	
41	Missouri	740.0	1.59	1.56	1.60	2.96	
42	Tennessee	58.6	1.69	1.64	1.92	3.39	
43	Virginia	38.6	2.99	2.85	2.92	5.30	
44	West Virginia	43.6	1.79	1.79	1.66	1.95	
Totals.....			25.00	25.03	26.11	39.45	Average of three items is \$2.97
Sub-average.....			1.92	1.92	2.01	3.03	8.90 4.02
Western group							
45	California	575.0	9.50	9.50	9.50	16.50	
47	Colorado	213.4	4.05	4.05	4.60	5.00	6.25
48	Iowa	27.1	1.87	1.95	2.61	3.73	
49	Iowa	14.0	1.85	1.90	2.00	2.55	
50	Kansas	67.8	2.50	2.44	3.16	3.76	
Totals.....			19.77	19.84	21.87	31.54	Average of one item is \$6.25
Sub-average.....			3.95	3.97	4.37	6.31	6.25 7.89

Average of all four group sub-averages

	DOLLARS PER TON						PER CENT OF INCREASE OVER 1915 COSTS		
							1916	1917	1918
Eastern group.....	2.99	2.98	3.80	5.96	7.04		27.5	100.0	138.3
Central group.....	2.44	2.41	2.77	3.75	6.38		14.9	56.4	164.7
Southern group.....	1.92	1.92	2.01	3.03	4.02		4.7	57.8	109.4
Western group.....	3.95	3.97	4.37	6.31	7.89		10.1	58.9	98.7
Average of group averages.....	2.82	2.82	3.24	4.77	6.33		14.9	69.2	124.4
Average of 41 works.....	2.63	2.62	3.04	4.52	5.69		15.3	73.7	117.1

Fuel oil, cents per gallon

37	Louisiana	372.0	2.7	1.80	1.80	2.00	4.50	11.1	150.0
45	California	575.0	1.785	1.38	1.50	2.57	3.55	86.2	157.3

* Mine run screenings

NOTE. For 1918, the average prices shown are for the first two or three months of the year only and are found by multiplying the 1917 average by the ratio of the sum of the items in 1918 to the sum of the corresponding items in 1917.

TABLE 7—*Concluded*
Data received too late to include in table

REF. NO.	STATE	POPULA- TION IN THOUSANDS	COAL, DOLLARS PER TON				3 months of 1918	
			1914	1915	1916	1917		
3	Boston, Mass. New York, N. Y.		2.93	2.86	3.55	6.06	3.323	
10								
20				1.45	1.496	2.439		
34								
46								
Fuel oil, cents per gallon								
20				7.0	8.0	10.0	12.0	

TABLE 8

Increase in cost of alum

REFER- ENCE NUM- BER	STATE	1914	1915	1916	1917	1918
Eastern group						
		<i>cts.</i>	<i>cts.</i>	<i>cts.</i>	<i>cts.</i>	<i>cts.</i>
6	Maine	1.33	1.78	3.37	2.30	2.33
7	New Hampshire	1.17	1.65	3.38	2.14	
11	Pennsylvania	0.985	0.985	0.985	1.345	
12	Pennsylvania	0.905	0.905	0.905	1.26*	
13	Pennsylvania	1.06	1.06	1.06	1.345	
14	Pennsylvania	0.87	0.87	0.87	1.225	1.30
16	Pennsylvania	0.935	0.935	0.935	1.295	
17	Pennsylvania	0.96	0.96	0.96	1.245	
19	Pennsylvania	1.025	1.0	3.0	1.17†	
Central group						
22	Indiana	0.96	0.96	0.96	1.28	
24	Indiana	0.93	0.93	0.93	1.28	
26	Illinois	0.91	0.91	0.91	1.216	
29	Wisconsin	0.92	0.92	0.92	1.255	
30	Wisconsin	0.87	0.87	0.87	1.205	
Southern group						
32	Alabama	1.20	1.20	1.20	1.50	
33	Arkansas	1.19	1.19	1.19	1.49	
35	Kentucky	0.575	0.575	1.12	1.100	
36	Kentucky	1.22	1.25	3.75	2.26	
38	Missouri	1.135	1.135	1.135	1.435	
39	Missouri	0.97	0.97	0.97	1.276	
40	Missouri	0.975	0.975	0.975	1.275	
41	Missouri	0.923§	0.923	1.136	1.271	
42	Tennessee	1.25	1.25	1.25	1.56	
43	Virginia	1.07	1.07	1.07	1.47	
44	West Virginia	0.935	0.935	0.935	1.26	
Western group						
47	Colorado	1.30	1.30	1.45	1.75	1.75 (3 mos.)
49	Iowa	0.97	0.97	0.97	1.276	

TABLE 8—*Concluded*

REFER- ENCE NUM- BER	STATE	1914	1915	1916	1917	PER CENT INCREASE OF COST OVER 1915	
						1916	1917
Averages by groups							
	Eastern (9).....	1.027	1.116	1.718	1.481	54.0	32.7
	Central (5).....	0.91	0.91	0.91	1.247	0.0	37.0
	Southern (9).....	1.074	1.078	1.379	1.477	28.0	37.0
	Western (2).....	1.14	1.14	1.21	1.513	6.1	41.4
Average of group av- erages.....		1.038	1.058	1.304	1.429	23.3	35.1
Average of 25 works..		1.031	1.068	1.395	1.435	30.6	34.4
20	Indiana		0.861	0.936	1.479		
New York market price		1.55	2.08	4.63	3.57	123.0	71.6

In using these data, the effect of old contracts carrying over this period is to be remembered. The relation between the prices paid and the current market prices are indicated in the above tabulation.

indicate a decline in quality of the coal of from 10 to 15 per cent, broadly speaking. The results are characteristic, rather than precise.

Carleton E. Davis, chief of the Bureau of Water of Philadelphia, reports that at one of their main pumping stations the increase in coal consumption during the past twelve months or so was 17.3 per cent per million gallons pumped, because of the inferior quality of the coal. At other stations a change in the type of pump or character of fuel used makes a comparison impossible.

Advance in price of alum. The record of prices paid by water works for alum, in cents per pound, is interesting and significant. It is to be borne in mind, however, that it reflects the leveling effect of long-time contracts under a rising market. This is indicated by comparison (table 8) of the prices submitted, with the average New York market prices, quoted from the *Journal of Industrial and Engineering Chemistry*.

The figures submitted indicate an advance in 1916 and 1917 over the prices of 1915, of approximately 30 and 24 per cent, whereas the advance in the New York market prices over the 1915 scale,

was 123 per cent in 1916, and approximately 72 per cent in 1917, the decline in the latter reflecting governmental control.

Some other operation supplies. Table 9 shows prices for sundry operating and maintenance supplies paid by the Indianapolis Water

TABLE 9

Prices paid for supplies used in operation and maintenance by the Indianapolis Water Company in 1915, 1916, 1917 and three months of 1918

ITEM	UNIT	1915	1916	1917	1918 QUOTATIONS	IN- CREASE OVER 1915 per cent
1. Coal.....	Ton	\$1.45	\$1.496	\$2.439	\$3.323	129
2. Alum.....	100 lbs.	.861	.936	1.479	1.939	125
3. Chlorine gas.....	100 lbs.	12.50	12.50	12.50	15.00	20
4. Oil, engine.....	Gallon	.179	.195	.25	.35	95
5. Oil, H. P. cylinder....	Gallon	.349	.35	.44	.555	59
6. Oil, L. P. cylinder....	Gallon	.234	.25	.34	.555	137
7. Oil, linseed oil.....	Gallon	0.84	0.78	0.97	1.50	78
8. White lead.....	100 lbs.	7.50	9.80	11.50	12.25	63
9. Electric power.....	K. W. H.	{ .01 .0125	{ .01 .0125	{ .015 .0175	{ .015 .0175	{ 50* 40*
10. Brass castings.....	Pound	.22	.35	.45	.50	127
11. Special cast iron casting.....	Pound	.0292	.0325	.0411	.0522	78
12. Steel boiler tubes 4 inches.....	Foot	.1675	.2285	.55	.60	258
13. Printing bills.....	1000	.76	1.23	1.42	1.91	151
14. Heat (M. H. Lt. Co.)..	Year	Cont.	Cont.	25%	Increase	25*
15. Rags (instead of waste).....	Pound	.05	.06	.07	.08	60
16. Gasoline.....	Gallon	.125	.175	.215	.25	100
17. Coal oil.....	Gallon	.07	.08	.10	.12	71

* Exclusive of demand charges.

Company, during 1915, 1916, 1917 and 1918, furnished by C. C. Cray, purchasing agent of the company.

Summary. In table 10 and figures 4 and 5 are summarized the increases in cost of labor and materials, already referred to.

TABLE 10

Summary of data upon increase in cost of labor and materials to water works in the United States is reported to the Executive Committee of the American Water Works Association, May, 1918

ITEM NO.	ITEM	NUMBER OF RECORDS	PRICES PER UNIT				INCREASE OVER 1915		
			1915	1916	1917	3 months 1918	1916	1917	3 months 1918
			cts.	cts.	cts.		per cent	per cent	per cent
1	Unskilled labor*—in cents per hour								
	a. Western group.....	7	27.0	28.5	31.4	Still in-	5	16	Still in-
	b. Central group.....	12	21.7	25.3	26.9	creasing	17	24	creasing
	c. Eastern group.....	15	23.0	26.7	30.4	in all	16	32	in all
	d. Southern group.....	10	17.9	20.6	24.5	groups	15	37	groups
	e. Average of groups (4).....	—	22.4	25.3	28.3		13	27	
	f. Average of all.....	44	22.1	25.2	28.3		14	28	
2	Cast iron pipe—per 2000 lbs.....	21	\$24.23	\$30.70	\$51.60		26.7	112.9	
3	6-inch valves.....	11	\$11.18	\$12.64	\$19.13	\$23.20	13.1	71.1	107.6
4	12-inch valves.....	3	34.78	41.53	65.22	69.00	19.4	87.6	98.7
5	2 way hydrants.....	6	\$26.69	\$32.04	\$43.13	\$53.90	\$20.1	\$61.6	\$102.0
6	Coal per 2000 lbs.								
	a. Eastern group.....	13	\$2.98	\$3.80	\$5.96	\$7.04	27.5	100	136.3
	b. Central group.....	11	2.41	2.77	3.75	6.38	14.9	56.4	164.7
	c. Southern group.....	12	1.92	2.01	3.03	4.02	4.7	57.8	109.4
	d. Western group.....	5	3.97	4.37	6.31	7.89	10.1	58.9	98.7
	e. Average of groups (4).....		2.82	3.24	4.77	6.33	14.9	69.2	124.4
	f. Average of all.....	41	\$2.62	\$3.04	\$4.52	\$5.69	15.3	73.7	117.1

7	Fuel oil, cents per gallon.....	1	cts. \$1.80	cts. 1.80	cts. 2.00	cts. 4.50	0.0	11.1	150.0
	Fuel oil, cents per gallon.....	1	cts. 1.38	cts. 1.50	cts. 2.57	cts. 3.55	8.7	86.2	157.3
8	Alum, cents per pound		cts.	cts.	cts.	cts.			
	a. Western group.....	2	cts. 1.14	cts. 1.21	cts. 1.51		6.1	41.4	
	b. Central group.....	5	cts. 0.91	cts. 0.91	cts. 1.25		0.0	37.0	
	c. Eastern group.....	9	cts. 1.12	cts. 1.72	cts. 1.48		54.0	32.7	
	d. Southern group.....	9	cts. 1.08	cts. 1.38	cts. 1.48		28.0	37.0	
	e. Average of groups (4).....		cts. 1.06	cts. 1.30	cts. 1.43		23.3	35.1	
	f. Average of all.....	25	cts. 1.07	cts. 1.40	cts. 1.44		30.6	34.4	
	g. New York market price†.....	‡	cts. 2.08	cts. 4.63	cts. 3.57	5 mos 3.15	123.0	71.6	51.4

* NOTE. It was generally reported that there has been also a marked decrease in efficiency of labor since the year 1914, variously estimated at between 20 per cent and 50 per cent; and that the increase in wages paid to labor by Water Work had not kept pace with contract prices owing probably to the advantage of continuity of service.

† See *Journal of Industrial and Engineering Chemistry*. Note that 1915 price was an advance of 34 per cent over the 1914 average price before the advances listed went into effect.

‡ Average of monthly prices.

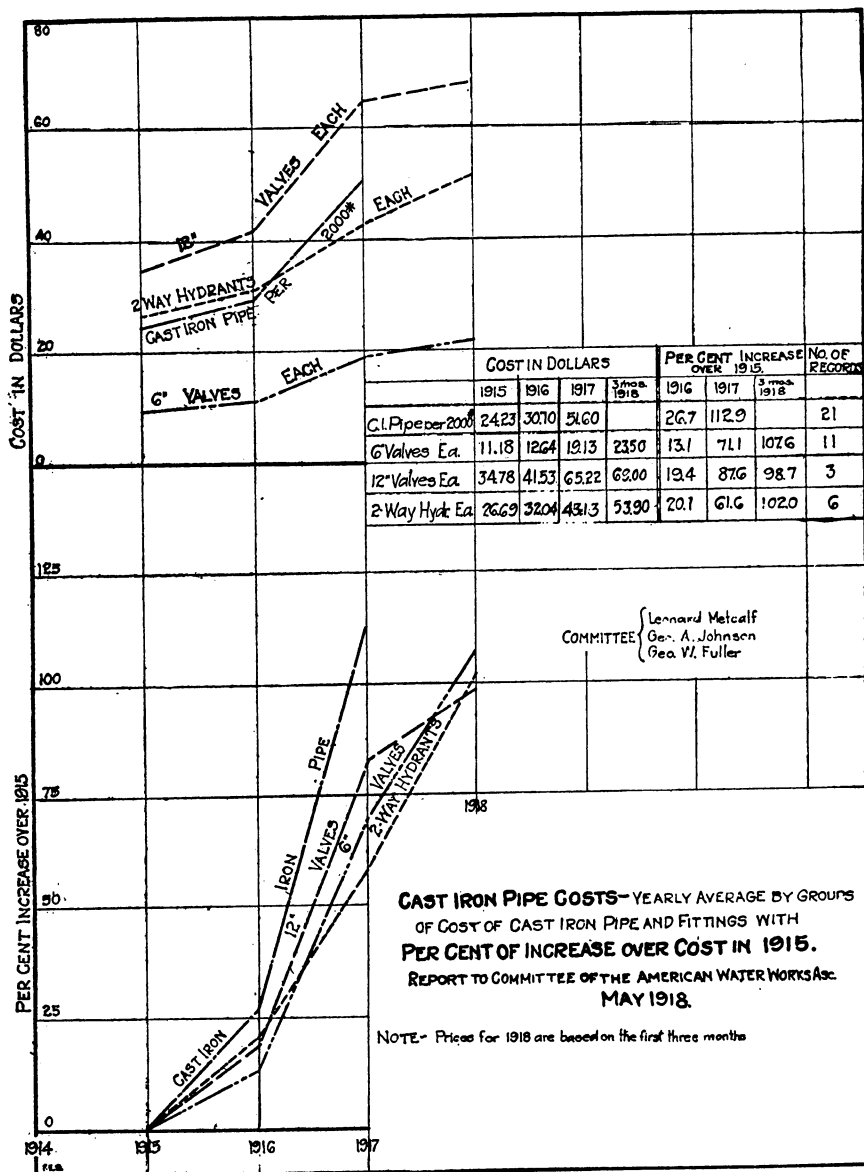


FIGURE 4

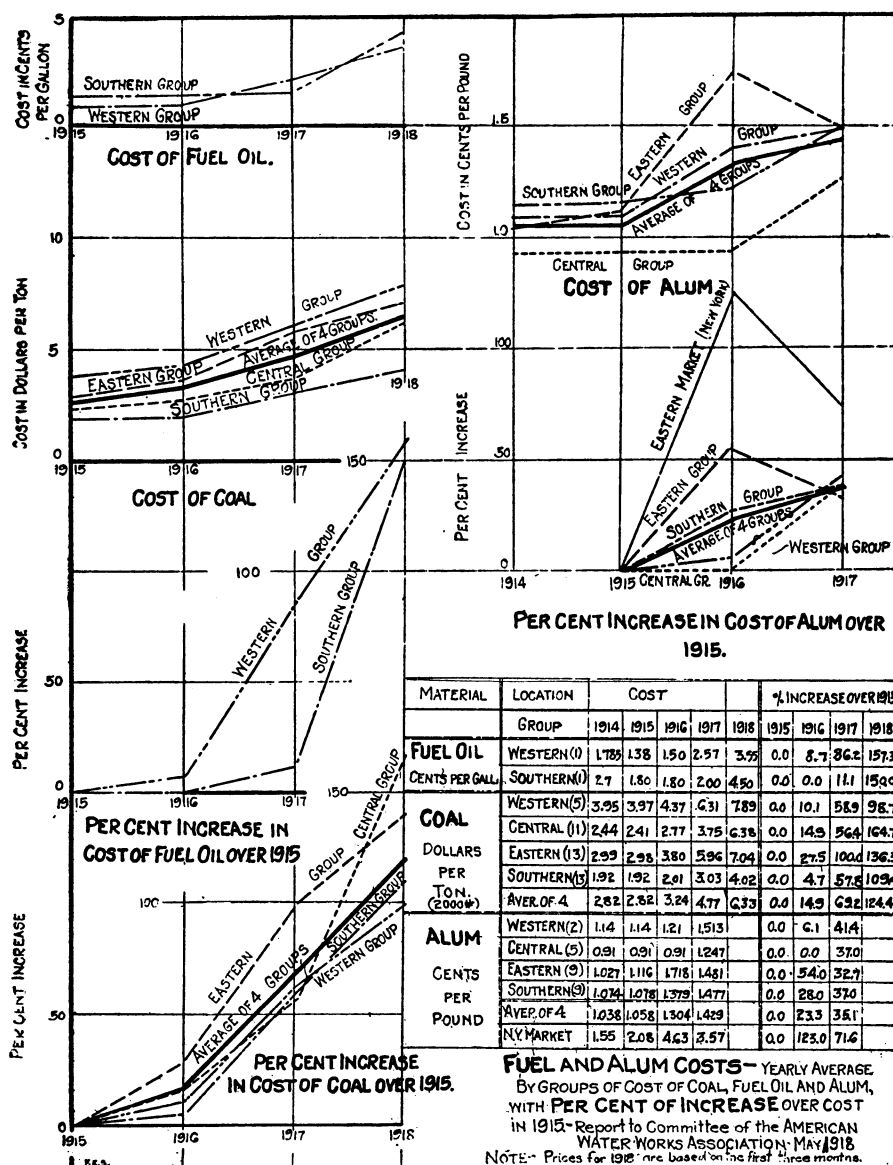


FIGURE 5

TABLE II
Percentage of revenue and operating expenses of values for year 1915 for water works companies in the United States

REFERENCE NO.	STATE	GROSS ANNUAL REVENUE IN PER CENT OF 1915					OPERATING EXPENSES AND TAXES EXCLUDING DEPRECIATION IN PER CENT OF 1915					OPERATING REVENUE APPLICABLE TO DE- PRECIATION, INTEREST, DIVIDEND AND SURPLUS IN PER CENT OF 1915							
		1913	1914	1915	1916	1917	Frac- tion of 1918	1913	1914	1915	1916	1917	Frac- tion of 1918	1913	1914	1915	1916	1917	Frac- tion of 1918
Western group																			
45	California		102.3	100	126.0	115.5				100	125.6	120.5				100	126.3	113.5	
46	California		94.3	100	100.2	105.7			93.4	100	102.5	103.5	113.6		94.9	100	98.4	106.8	
47	Colorado		98.4	100	100.8	104.1		102.7	100	101.1	101.2				74.9	100	99.3	115.8	
48	Iowa		103.9	100	109.2	114.3		98.9	100	112.2	117.1				108.2	100	106.5	111.8	
49	Iowa		98.1	100	107.3	106.3		97.3	100	112.2	140.2				98.3	100	98.4	86.1	
50	Kansas		99.6	100	108.8	114.9		99.8	100	111.5	149.6				99.5	100	107.4	96.6	
51	Oregon		118.9	100	106.2	100.3		108.3	100	106.1	109.4				142.3	100	106.5	75.5	
52	Washington		98.1	100	100.2	115.0		89.9	100	198.6	97.6				107.7	100	90.5	135.9	
Total.....			813.6	800	858.8	876.1			690.3	800	879.8	939.1			725.8	800	833.3	842.0	
Average of group.....			101.7	100	107.3	109.5			98.6	100	109.9	117.4	113.6		103.6	100	104.3	105.3	
Average of records.....			98.9	100	106.1	108.0			99.5*	100	106.5	105.8			94.5	100	105.8	110.3	
Central group																			
20	Indiana		96.1	100	108.0	108.0	107.0		96.1	100	135.8	154.1	154.9		96.2	100	96.6	89.6	
21	Indiana		92.9	100	111.4	114.8		102.3	100	122.6	144.3				88.0	100	105.8	100.2	
22	Indiana		97.6	100	101.1	91.0		104.3	100	121.0	123.8				93.2	100	87.2	68.1	
24	Indiana		99.8	100	106.2	114.1		102.8	100	130.0	148.9				96.9	100	94.0	96.6	
25	Michigan																		
26	Illinois		100.6	100	112.3	117.9		90.6	100	114.9	132.1				107.5	100	110.6	108.4	

27	Ohio	80.7	100	126.1	131.0			88.6	100	128.0	157.5		61.0	100	122.1	65.7
28	Wisconsin	101.7	100	105.5	120.4			96.3	100	102.2	130.5		109.3	100	110.5	111.5
39	Wisconsin	96.1	100	101.6	101.3			99.2	100	114.2	133.4		94.2	100	92.8	77.8
30	Wisconsin	94.1	100	112.0	111.3			121.0	100	124.0	135.0		63.5	100	99.4	84.6
31	Wisconsin	97.6	100	116.3	118.2			95.9	100	126.1	151.0		99.0	100	111.1	101.8
Total		957.2	1000	1100.5	1128.0	107.0		997.1	1000	1218.9	1410.6		908.8	1000	1030.1	904.5
Average of group		95.7	100	110.1	112.8	107.0		99.7	100	121.9	141.1	154.9	90.9	100	103.0	90.6
Average of records		97.6	100	109.8	116.7			95.6	100	125.0	144.1		98.6	100	97.7	94.2
Eastern group																
1	Massachusetts	101.6	100	105.5	100.3			100.7	100	103.5	119.2		102.0	100	106.5	90.4
2	Massachusetts	95.3	100	106.0	102.4			101.2	100	99.1	114.1		90.2	100	111.4	92.2
3	Massachusetts	97.2	100	100.4	100.8			114.8	100	113.0	129.6		84.7	100	91.9	80.7
4	Massachusetts	94.5	100	108.1	105.8			96.8	100	123.1	139.0		91.4	100	87.6	84.9
5	Connecticut	95.2	100	110.6	121.5		88.6	108.3	100	103.3	147.3	100.3	92.7	100	116.3	101.8
6	Maine	109.6	100	114.6	126.3			101.8	100	102.1	119.6		128.8	100	145.1	143.1
7	New Hamp- shire	98.9	100	102.8	105.6			85.6	100	114.4	118.5		110.0	100	93.2	94.8
8	New Hamp- shire	100.0	100	102.2	106.2	109.8		100.2	100	90.8	101.8	114.1	99.8	100	111.7	110.3
9	New York	102.3	100	110.6	119.2	120.8		105.2	100	85.8	111.2	125.3	99.3	100	135.8	127.0
10	New York	98.1	100	108.7	114.9			110.2	100	100.0	117.6		94.3	100	111.5	114.0
11	Pennsylvania	97.5	100	116.6	111.3			101.8	100	140.1	181.5		95.8	100	106.9	86.3
12	Pennsylvania	103.8	100	110.6	114.2			103.3	100	117.9	170.6		102.0	100	105.6	81.2
13	Pennsylvania	96.2	100	108.5	117.3			106.1	100	99.0	151.5		89.1	100	115.9	92.4
14	Pennsylvania	93.1	100	120.0	109.0			89.2	100	124.4	177.1		95.6	100	117.4	67.7
15	Pennsylvania															
16	Pennsylvania	94.3	100	113.7	119.8			92.3	100	116.8	161.5		95.2	100	112.1	98.0
17	Pennsylvania	102.2	100	101.1	109.5			104.6	100	127.8	183.6		101.3	100	90.6	80.0

TABLE 11—Continued

STATE	GROSS ANNUAL REVENUE IN PER CENT OF 1915					OPERATING EXPENSES AND TAXES EXCLUDING DEPRECIATION IN PER CENT OF 1915					OPERATING REVENUE APPLICABLE TO DEPRECIATION, INTEREST, DIVIDEND AND SURPLUS IN PER CENT OF 1915							
	1913	1914	1915	1916	1917	Frac-tion of 1918	1913	1914	1915	1916	1917	Frac-tion of 1918	1913	1914	1915	1916	1917	Frac-tion of 1918
Eastern group—continued																		
18	Pennsylvania	98.2	100	105.0	105.9			92.4	100	101.1	98.7			100.0	100	106.3	108.0	
19	Pennsylvania	85.1	100	111.2	124.3	129.6		103.1	100	104.1	131.5	181.0		89.1	100	115.6	119.6	97.2
	Total	1767.4	1800	1965.2	2014.3			1817.6	1800	1966.3	2473.1			1761.3	1800	1981.0	1772.4	
	Average of group	98.3	100	109.1	111.4			100.9	100	109.3	137.3			97.3	100	110.0	98.5	
	Average of records	97.8	100	105.0	105.5			100.8	100	95.9	112.7			96.5	100	105.7	95.8	
Southern group																		
32	Alabama	106.7	100	111.8	125.2			98.7	100	99.6	120.4			112.2	100	120.3	128.4	
33	Arkansas	101.8	100	108.1	141.5			104.1	100	108.8	161.1			100.1	100	107.5	127.9	
34	Florida	98.4	100	106.8	110.4			101.4	100	115.3	135.1			96.9	100	99.0	93.5	
35	Kentucky	94.8	100	105.8	109.5			98.7	100	106.4	114.1			83.3	100	104.2	94.9	
36	Kentucky	106.6	100	104.0	114.8			111.1	100	112.7	133.8			100.8	100	92.7	90.2	
37	Louisiana	87.9	100	109.0	117.0			85.8	100	114.2	121.1			92.2	100	98.2	108.5	
38	Missouri	86.5	100	111.6	115.9			84.7	100	124.3	142.8			89.4	100	103.1	97.8	

39	Missouri	100.9	100	104.4	115.6				98.7	100	112.8	122.8			104.5	100	91.3	104.3
40	Missouri	101.8	100	108.3	139.9				105.8	100	108.1	138.2			99.8	100	104.6	96.2
41	Missouri	88.0	100	108.9	114.2			94.7	99.6	100	104.5	132.2		95.0	79.1	100	112.5	100.3
42	Tennessee	97.2	100	109.5	130.2				98.0	100	112.3	160.1			96.6	100	107.7	108.1
43	Virginia	97.7	100	103.4	121.7				95.1	100	113.0	158.0			98.0	100	97.1	99.8
44	West Virginia	100.9	100	105.8	108.5				79.3	100	94.3	110.4			119.2	100	115.3	106.9
Total		1270.2	1300	1397.4	1564.4				1261.0	1300	1426.3	1750.1			1272.1	1300	1252.5	1356.8
Average of group		97.7	100	107.5	120.3				97.0	100	109.7	134.6			97.9	100	96.3	104.4
Average of records		93.8	100	109.0	115.0				97.0	100	111.0	130.0			90.2	100	107.0	105.0

Summary of Groups. Per cent of 1915

Western	101.7	100	107.3	109.5					98.6	100	109.9	117.4			103.6	100	104.3	105.3
Central	95.7	100	110.1	112.8					99.7	100	121.9	141.1			90.9	100	103.0	90.4
Eastern	98.3	100	109.1	111.4					100.9	100	109.3	137.3			97.3	100	110.0	98.5
Southern	97.7	100	107.5	120.3					97.0	100	109.7	134.6			97.9	100	96.3	104.0
Total	393.4	400	434.0	454.0					396.2	400	450.8	530.4			389.7	400	413.6	398.2
Average of groups	98.3	100	108.5	113.5					99.0	100	112.7	132.6			97.4	100	103.4	99.5
Average of records	96.6	100	106.0	109.0						100	106.0	119.0			87.0	100	106.0	102.0*

TABLE II—*Concluded*
Data arriving too late to be included in original tabulation

	GROSS ANNUAL REVENUE IN PER CENT OF 1915				OPERATING EXPENSES AND TAXES IN PER CENT OF 1915				OPERATING REVENUE, APPLICABLE TO DE- PRECIATION, INTEREST, DIVIDEND AND SURPLUS IN PER CENT OF 1915			
	1914	1915	1916	1917	1914	1915	1916	1917	1914	1915	1916	1917
Eastern group												
New York City	98.5	100	112	100.2		100	99	88†		100	103.5	105

In reviewing these statistics—which indicate that in spite of drastic curtailment of operating expenses, the normal growth in revenue necessary to carry the increase in investment, the net revenue, is on the average declining—the difference in position of the water works having to pump and filter their supplies as compared with those having unfiltered, gravity supplies is to be remembered. The former are feeling the greater financial burdens in much greater measure than the latter.

* Value would be lower if large western water works were omitted.

† Reduction in operating expenses due to reduced pumping after introduction of Catskill supply.

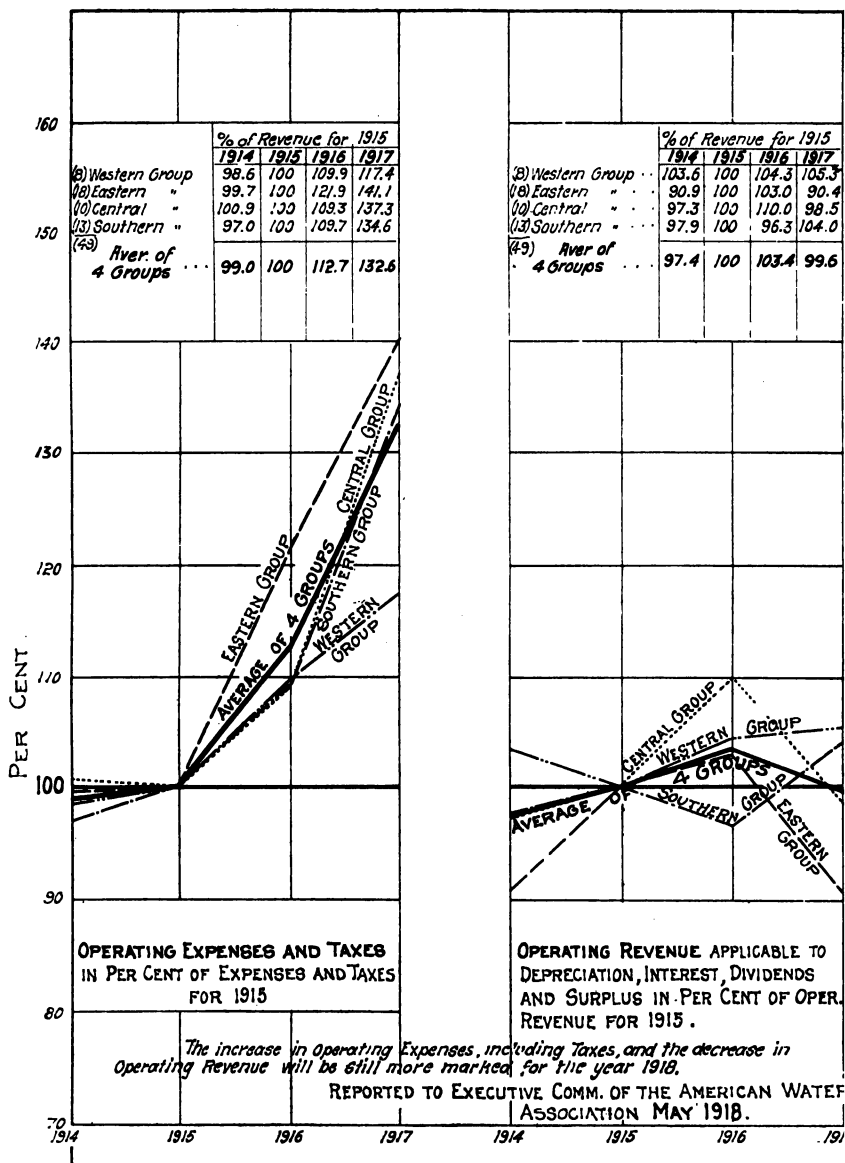


FIG. 6

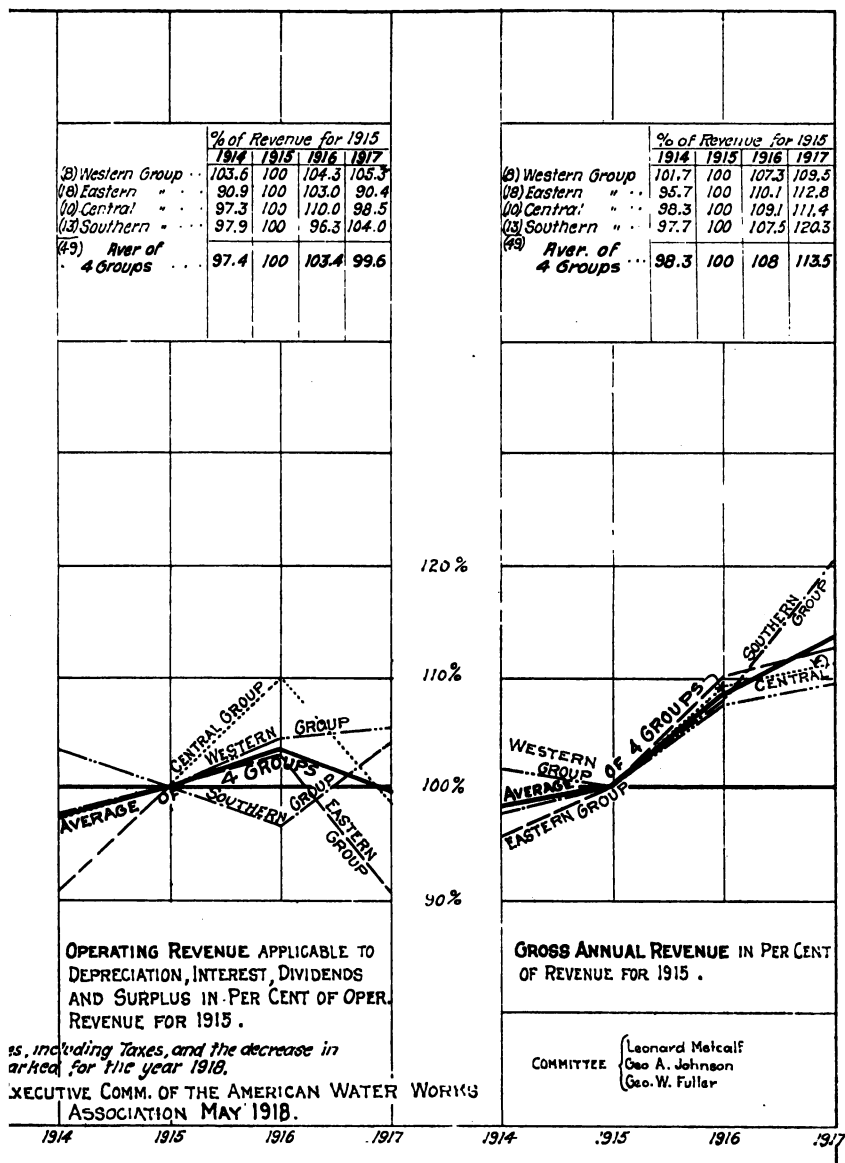


FIG. 6

WATER WORKS OPERATION AND MAINTENANCE COSTS

Returns were received from about fifty important water works concerning their gross annual revenue, operating expense including taxes but excluding depreciation allowance, and the resulting operating revenue applicable to depreciation allowance, fixed charges, dividends and surplus. These results have been analyzed and put into comparative percentage form, in order that the change in conditions might readily be understood. Inasmuch as a number of these records were given in confidential manner, with the understanding that the names of the corporations would not be mentioned, there has been recorded merely the state in which the works were located. The works have been assembled in four major groups, the western, the central, the eastern, and the southern, and are shown in table 11. A summary of groups gives averages for each of the groups and the average of the four group averages, and the averages of all of the records cited.

These records indicate, as do the construction records, that no marked change in conditions was felt until 1916; that the gross annual revenues for 1916 and 1917 were respectively 6 and 9 per cent in excess of those for 1915, but slightly more than those for 1914 on the basis of all of the records received, or 8.5 and 13.5 per cent on the basis of the average of group averages. The normal advance in gross revenue, corresponding to the growth in population and in investment, would probably have exceeded 6 per cent per annum and may have been substantially greater than this amount.

The increase in operating expenses over those of 1914-1915 was 6 and 19 per cent for 1916 and 1917, respectively, on the basis of all the records received, and 12.7 and 32.6 per cent on the basis of the average of the group averages.

The resulting operating revenues applicable to the depreciation allowance, fixed charges, dividends and surplus for 1916 and 1917, were respectively 6 and 2 per cent in excess of those for 1915, all on the basis of the average of all of the records received; and 3.4 and 0 per cent, respectively, in excess of 1915, on the basis of the average of the four group averages.

Broadly speaking, therefore, it appears from table 11, as from the graphical representation shown in figure 6, that the increase in operating expense has substantially absorbed the normal increase in gross revenue and has left no revenue to carry the burden of

TABLE 12

Data on increase in operating expenses of some American water works

Under date of May 31, 1918, F. C. Jordan, Secretary of the Indianapolis Water Company, wrote independently to a number of the leading water plants of the country, requesting information in reference to their increase in operating expense, and readjustment of rates to offset, in part, this increased cost of operation. Up to June 10, 1918, answers had been received from about forty or fifty of these cities. These answers indicate the following increases in operating expenses during the past six months, as compared with the normal pre-war operating expenses.

Increase over normal operating expenses

		REPORTED IN- CREASE
		<i>per cent</i>
1	Savannah, Ga.....	20
2	Richmond, Va.....	25
3	Milwaukee, Wis.....	36
4	Brockton, Mass.....	28.6
5	Champaign, Ill.....	30
6	Nashville, Tenn.....	25
7	Mobile, Ala.....	30
8	Philadelphia, Pa.....	35
9	Jamestown, N. Y.....	56
10	Toledo, Ohio.....	32
11	St. Catherines, Ont.....	25
12	Elmira, N. Y.....	33
13	Worcester, Mass.....	35
14	Paterson, N. J.....	16
15	Cincinnati, Ohio.....	25
16	Springfield, Ill.....	20
17	Springfield, Mo.....	25
18	Springfield, Mass.....	17
19	Peoria, Ill.....	25
20	Jersey City, N. J.....	15
21	Decatur, Ill.....	35
22	Cleveland, Ohio.....	31
23	Des Moines, Iowa.....	47
24	Schenectady, N. Y.....	20
25	Xenia, Ohio.....	33
26	Flint, Mich.....	18
27	Providence, R. I.....	52
28	Colorado Springs, Colo.....	25
29	Atlanta, Ga.....	40
30	Kansas City, Mo.....	35
31	Dayton, Ohio.....	21
32	Lansing, Mich.....	30
Average		29

TABLE 12—*Concluded*

Quite a number of the water departments have increased their water rates within the past year or so, and others report that they are petitioning for an increase or contemplate doing so in the near future. Among those that have increased their rates are the following:

Atlanta, Ga., reduced its discount for prompt payment from 25 per cent to 10 per cent.

Cincinnati, Ohio, increased its rates 25 per cent, this increase affecting all water consumers.

Dayton, Ohio, increased its annual minimum on $\frac{3}{4}$ -inch meters from \$4.40 to \$6.60. This amount covers a quarterly consumption of 1000 feet in addition to the meter rental.

Flint, Mich., increased the rate to its large consumers from 5 cents per thousand gallons to 8 cents.

Brockton, Mass., increased its rates to all consumers.

Philadelphia, Pa., increased its metered water rates 30 per cent.

Richmond, Va., increased its rates to large consumers from $3\frac{1}{4}$ cents per thousand gallons to 5 cents.

Detroit, Mich., put into effect an increase covering all consumers, and is now considering an additional increase.

Toledo, Ohio, increased its water rates on October 12, 1916, and is now figuring on another increase.

Savannah, Ga., increased its rates to all water consumers.

Toronto, Canada, increased its rates 10 per cent in 1917, and an additional increase of 25 per cent became effective in the early part of this year.

The following cities are petitioning for increase, or contemplate doing so in the very near future: Champaign, Ill.; Davenport, Iowa; Hamilton, Ohio; Racine, Wis.; Springfield, Mo.; Tampa, Fla.; Worcester, Mass.; Kent, Ohio, etc.

additional investments. There is marked decline in revenue in the eastern group, however.

Interesting similar data on increase in operating expense of some of the more important water works in the United States were obtained by Mr. Frank C. Jordan, Secretary of the Indianapolis Water Company, and are given in table 12.

SUMMARY OF FINDINGS

Records received from 50 typically important water works in the United States, indicate

(a) That the advance in the cost of labor used by water works in construction work during the past three years was approximately 13 per cent in 1916 and 27 per cent in 1917, over the pre-war costs

in this country. These pre-war costs were fairly reflected by prices prevailing in the year 1915.

Material decrease in efficiency of labor has also been observed in all parts of the country, the consensus of opinion indicating an approximate loss in efficiency of from 25 to 35 per cent.

(b) The important water works construction materials, pipe, valves, hydrants, etc., have more than doubled in cost.

The more important operating materials, such as coal and fuel oil, have also more than doubled and chemicals for the treatment of the water have advanced from 50 to 100 per cent and more.

(c) The normal annual increase in revenue of the water works of this country has in general decreased, except where war activities have materially increased the local market for water.

(d) The operating and maintenance expenses have increased approximately one-third, the increase in gravity works being of less serious moment generally, than in the pumping plants.

(e) The net revenues applicable to depreciation allowance, fixed charges, dividends, and surplus have, in general, remained about stationary, instead of increasing substantially from year to year, thus indicating that the new investment is not being taken care of, and that the divisible revenue is declining. The conditions vary markedly at individual plants and in groups, the eastern group showing the most marked decline in net annual revenues. Unfortunately the conditions are growing more and more serious.

CONCLUSIONS

First. That the water works of the United States have suffered, through war conditions, large increase in construction and operation costs.

Second. That marked decline in net revenue has resulted.

Third. These conditions did not begin to make themselves generally felt until late in 1916, and it was not until the latter part of the following year that they became serious. The desirability and continuity of employment tended to delay the advance in wages.

Fourth. The advance in cost of labor used in extension and minor construction work, by water works in this country, has gathered force in the last six months, and it is the general opinion of municipal and corporate managers that additional increases are certain to come during 1918 and thereafter, if labor is to be held.

Fifth. It is undesirable to replace old, well-trained forces, familiar with these water works properties, with other labor not having this familiarity, in the effort to hold the wages at a point below the general local standard for similar service. The character of the service would suffer and it would not be fair to labor.

Sixth. Serious and conscientious effort has been made by water works operators generally to reduce construction and operating forces to a minimum.

These reductions have in many cases already gone beyond desirable limits, even to reducing the working efficiency of the properties.

In other cases still greater economies are possible in better consumption of coal; waste reduction by increased use of controlling meters, pitometer surveys, and more frequent house to house inspection, and in quarterly instead of monthly meter readings of small meters.

Seventh. The general situation is a very serious one and has shown itself in increasing difficulty of attracting capital for necessary betterments. While extension of service is likely to be increasingly limited with the conditions of war, it would be unfortunate, if the activities of important industrial and commercial centers, particularly those concerned in governmental activities, should be thus circumscribed.

Eighth. The menace of the situation lies in the increasing difficulty under such conditions of maintaining constantly a water service safe from a sanitary standpoint, necessary for good fire protection service, and adequate for industrial, commercial and domestic needs.

Ninth. Public Service Commissions and other regulatory bodies have already recognized the danger of the present situation to the public as well as to the utilities, and are likely at least to afford such relief as may seem to them necessary to maintain credit, but it is imperative for water works operators to keep clear records, showing the actual change in conditions and prices of materials and labor, that these bodies may have uncontestable proof upon which to pass judgment as to the necessity for relief.

Tenth. It is imperative, in the interest of good service, that water works operators of municipally as well as corporately owned plants, should anticipate their construction and operation needs, as far as possible, and should be careful to obtain the necessary priority orders, that the quality of the water and the service rendered may

not be seriously impaired in the future for want of construction and operation materials and supplies.

Respectfully submitted,

LEONARD METCALF, *Chairman*,

GEORGE A. JOHNSON,

GEORGE W. FULLER.